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UITGEGEVEN DEN

2 AUG. 1934

PATENT SPECIFICATION

Application Date: Jan. 19, 1933. No. 1824/33. **413,027**

Complete Accepted: July 12, 1934.

COMPLETE SPECIFICATION.

Improvements in or relating to the Connecting of Metallic Members by Screwed Joints.

I, Hugues Louis Dardelet, a citizen of the French Republic, of 5, Rue Menou, Nantes (Loire-Inférieure) France, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The coupling of two cylindrical tubes or again of two cylindrical solid bars made of a metal or an alloy, in a strong and, if necessary, fluidtight manner, is obtained by wholly threading in advance the portions of the tubes or bars that are engaged in the coupling member. It has been proposed to couple a smooth cylindrical part to a threaded conical female part by driving with a helical rotary movement the cylindrical part into said female part, the threads of which bite into the metal of the cylindrical part, but this system of coupling possesses but a low resistance to bending and tearing stresses, due to the small length of the threaded parts engaged together.

According to the invention there is provided a method of coupling together male and female metallic parts, adapted to resist tearing and bending stresses, one of the parts being threaded and of a hard material and another being non-threaded and of less hard material, so that by forcing one part into or onto the other and rotating, screw threads will be formed in or on the non-threaded part; characterized in that one of the parts is cylindrical, whilst the other one is cylindro-conical, that is to say it forms a conical inlet portion followed by a cylindrical portion, the diameter of the non-threaded cylindrical portion and the diameters of the threaded cylindrical portion measured at the bottom and at the top of the threads respectively being so arranged that the metal or matter of the non threaded part that is crushed by the screwing of the threaded part can be housed between the teeth of threads of the threaded part, that is to say that there remains a slight play or clearance between the bottom of the threads of the threaded part and the top of the threads formed in the non-threaded part.

[*Price* 1/-]

The invention also consists in a method of coupling male and female members, wherein a cylindro-conical portion of one of the members is prolonged, on the side opposite to its inlet end, by a conical portion, that is to say a portion (such as i^3 Figure 13) which diverges from the common axis of the parts to be assembled when the screw-threaded member is a male member, the part of the female member engaging therewith being smooth.

It will be understood that if this slight play or clearance does not exist, the crushed metal would not find room enough between the teeth or threads of the threaded part, which would then immediately be jammed.

This condition is fulfilled when the diameter of the non threaded cylindrical portion ranges either between the diameter at the bottom of the threads of the screw threaded cylindrical portion and the arithmetical mean of this diameter and of the diameter at the top of the threads of the threaded portion $\left\{D^2<D^1<\frac{D^2+D^3}{2}\right\}$, in the case of Figure 4, when the non-threaded cylindrical face is on the male part, or between the arithmetical mean of these two diameters and the outer diameter of the screw threads $F>D>\frac{e+f}{2}$, in the case of Figure 12, when the non-threaded cylindrical part is in the female part.

The coupling member which is employed for connecting together the rods or tubes is provided with outer or inner conical threads of the single or multiple type of very small pitch in the case of single threads, and of very small length of tooth or thread in the case of multiple threads, prolonged in the direction of the median part of the coupling member by threads of the same profile. The coupling member is made of a metal or alloy harder than that of the rods or tubes to be connected together, or its threads are suitably hardened (for instance through a case hardening treatment), so as to bite into the metal of the rods or tubes and to cut threads therein when the rods or tubes are introduced, and rotated about

their axes, in the coupling member, or inversely, so that the coupling is obtained by forcing.

As the entering conical portion is prolonged by a cylindrical portion which gives a very high resistance to bending and to tearing but a diminished fluid-tightness at very high pressure, the coupling members are given the same qualities of fluidtightness, for the tubes, or a permanently good radial grip, for the bars, even if the coupling has been taken to pieces several times, by prolonging the cylindrical portion by a second conical portion.

In coupling male and female metallic parts, the cylindro-conical portion of one of the members may be prolonged, on the side opposite to its inlet end, by a converging conical portion, that is to say, a portion that narrows or tapers toward the common axis of the parts to be assembled (see the portion a^3 Figure 6) in the case where the screw-threaded member is the female member, the male member for engagement therewith being smooth ended.

Various ways of carrying the invention into effect are illustrated by the accompanying drawings, in which:—

Figure 1 shows a cylindro-conical coupling member;

Figure 2 shows how one tube is inserted into the cylindro-conical coupling member;

Figure 3 shows a coupling member having external screw threads;

Figure 4 shows a coupling member having internal and external screw threads:

Figure 5 shows a bolt with its head and its nut set by forcing;

Figure 6 shows a coupling member with annular grooves;

Figure 7 shows the assembling of a hard cylindrical threaded rod in a soft unthreaded member;

Figures 8 to 11 are sectional views illustrating the assembling of parts such as metal sheets by means of a cylindro-conical threaded rod forming a rivet;

Figures 12 and 13 show a cylindro-conical member forming a stud bolt or set bolt;

Figure 14 shows a modification of the arrangement shown in Figures 8 to 11, and

Figure 15 shows a modification of the stud bolt of Figure 12.

Referring to Figures 1 and 2 of the drawings, the method of assembly is effected by means of a union or female member a threaded internally and provided at the ends with conical parts a^1 and a^2, the part a^3 extending between the lines x—x being of cylindrical formation. This union is employed for joining or connecting two smooth ended tubes or rods, such as c.

The screw threads, either of the single or of the multiple threaded type, have a very small width, or, in the case of a single threaded screw, a very small pitch which may vary, according to the size of the coupling member, between about 2 millimeters and 0.1 millimeter.

The profile of the thread is generally of the isosceles triangular type, either truncated (International System Sellers) or rounded off (Whitworth); it may also be of the unequal triangular type. Furthermore, the coupling member is made of a very hard metal, or, if the metal is soft, the threads are hardened through a known process (case-hardening, prussiate hardening, etc.) so that the threads of the coupling member are always harder than the metal of the cylindrical tubes or bars, such as c, to be coupled. The rods or bars are circular or of any other convenient shape in cross-section.

The diameter of the cylindrical thread a^3 is such that the tube or bar c, after having formed its threads along conical threads a^1, a^2 can screw in cylindrical thread a^3 without any further deformation of the material of the tube. For instance, in order to connect together two rods of 20 mm. diameter D^1, Fig. 2, in a coupling member the cylindrical middle part of which is provided with threads the outer diameter of which is D^3, while their inner diameter is D^2, it is necessary to so choose D^1 that: $D^2 < D^1 < \frac{D^2+D^3}{2}$. Under these conditions the length of the coupling, that is to say the length along which the threads are in contact can be very great.

One of the advantages of the method of coupling together tubes or rods by means of cylindro-conical coupling members consists in that the threads produced on the tubes or rods by a permanent deformation of the metal are radially compressed with a great strength in the threads of the coupling member, which prevents the accidental unscrewing of the coupling member.

It will be readily understood that the coupling members cannot only be rectilinear for two tubes or bars of the same diameter, but also be of any shape that is known for coupling members; rectilinear with unequal diameters, bent with diameters which may be equal or not, T-shaped with diameters that may be equal or not, adapted to act as stoppers at the ends of tubes, etc.

Obviously the threads of the coupling members may be either both right hand

threads, or both left hand threads, or again right hand threads at one end and left hand threads at the other end.

The coupling member may even be a part of a piece that is much more bulky than itself. For instance a cylindro-conical threaded hole may constitute a coupling member adapted to receive a non-threaded tube or stopper.

The coupling member shown in Fig. 3 is provided with external threads and utilised for tubes that do not serve to convey any liquid or gas, for instance of the type used in metallic frames. Should it be necessary to circulate a gas or liquid therethrough, without local decreases of section being of importance, such coupling members can obviously be utilised by piercing holes therethrough.

The method for mounting the coupling members provided with external threads is analogous to that described with reference to the coupling members having internal threads, the tube being engaged on the coupling member instead of being inserted therein.

The median portion a^4 of the coupling member may be of any suitable outline, cylindrical, hexagonal, or provided with tenons.

When it is desired to have a very high resistance to bending efforts, use is made of a coupling member of elongated shape, and the tube or bar is provided with one or several annular grooves j (Fig. 2) having a depth at least equal to that of the threads of the coupling member, so that, along said part or parts of the tube or bar, the threads of the coupling member do not exert any action whatever, and the tube or bar can be introduced to a greater distance. It is also possible to provide the groove or grooves on the coupling member itself, as shown at l, in Fig. 3.

The coupling member shown in Figure 4 is provided with internal and external threaded portions.

The method described above for coupling together tubes or bars can also be used for coupling together mechanical pieces such as a shank and a head or nut so as to obtain a whole which can be called a "removable rivet". The removable rivet consists of a smooth shank at the ends of which I may fix, through the method above described a semi-coupling or a coupling playing the part of a rivet head, and a semi-coupling or coupling playing the part of a nut. By semi-coupling, I mean a coupling of the form described above but comprising only one conical inlet on one side.

Fig. 5 shows the whole which is thus obtained, the head a^5 consisting of a semi-coupling and a nut a^6 consisting of a coupling.

The head and the nut are threaded and hardened. They have a conical inlet portion provided with very small threads. Rod c^1 is smooth and cylindrical. The head-coupling a^5 is first introduced on rod c^1 by suitably guiding it. Such operation can be performed on a lathe or in a vice, with suitable guiding means.

The rod is fully screwed until its end comes into contact with a projection (obtained for instance by stamping) provided on the outer face of the head, as shown at s (Fig. 5).

The shank provided with its head is inserted into the holes of the parts to be assembled together and the nut is placed onto the free end of the shank.

The nut is then fully screwed while the head is being held firmly.

In the coupling member shown in Fig. 6, the cylindrical threaded portion a^3 is prolonged by a conical threaded portion a^9, having the same profile and the same pitch and the angle of which is small (for instance from 2 to 6°), converging toward the axis of the coupling member. As shown in Fig. 6, the conical and convergent threaded portion a^9 is provided at the end of cylindrical threaded portion a^3 and on the side opposed to inlet portion a^6.

Under these conditions, tube c, engaged and screwed in the coupling member as shown in dotted lines in Fig. 6, after it has moved past the cylindrical portion a^3, is wedged in the convergent conical portion a^9, thus affording an efficient fluid-tightness. When a bar or rod is inserted in the coupling member instead of the tube c, the bar again finds in the convergent conical portion a^9 of the coupling member a radial grip and is thus always strongly held. The threaded portion a^9 is obviously conical at the tops and the bottoms of the threads. Recesses k may be provided between parts of the threaded portions a^3 and a^9.

What has been said of the assembly comprising a screw-threaded female member, for instance, the assembly shown in Figure 6, is equally applicable to a screw-threaded male member. That is to say, the screw-threaded male member may, at the side opposite to the entering conical part, have an additional conical part as shown at i^3 in Figure 13, the said additional conical part diverging gradually from the common axis of the conical and cylindrical parts.

It has been stated above that the profiles of threads to be used for the coupling members were of the single or multiple type, with an isosceles or triangular profile more or less rounded off or truncated

at the bottom, as, for instance the Whitworth.

For tubes of say more than 60 millimeters in diameter, the employment of this type of thread only, necessitates if the parts are tightened manually with a spanner of say 1 metre in length, the use of very small pitches and cones of relatively large apex angle, which makes it difficult to center the thread through the method above explained and to reassemble the parts when they have been taken to pieces.

It has been explained above that the coupling members are threaded and harder than the bars or tubes to be coupled, which are smooth cylinders.

In some cases it may be of interest to invert the arrangement. In other words, the threaded metal made of harder or hardened metal is cylindrical and the softer parts to be coupled together are conical or cylindro-conical. For instance I may insert on a hard or hardened threaded rod c^2, Fig. 7, a non threaded nut a made of a softer metal, the end a^2 of which is conical, while the inside a^3 is cylindrical, as shown.

The parts are assembled in the same manner as above stated for the insertion of a smooth rod or tube into a threaded cylindro-conical coupling, but they are of course reversed, which means that the inner diameter d of the smooth cylinder or nut must comply with the following condition: $\frac{e+f}{2} < d < f$.

By cutting a female cylindro-conical coupling member as hereinbefore referred to it was possible to constitute a form of bolt, which was called "removable rivet", and which is shown at a^5 in Fig. 5. It is also possible to cut into two parts a male cylindro-conical coupling member of the form shown in Fig. 3 and thus to form a screw having hard threads, which is threaded into a non-threaded member having a cylindrical inner surface or hole.

The aforesaid embodiments of half-couplings having hard threads provided on their surfaces is particularly interesting as applied to the coupling of parts that are generally assembled by means of rivets, or of parts that are to be secured to thicker parts. This embodiment and the advantages thereof will now be described with reference to Figs. 8 to 11, which show two metallic parts A and B provided with cylindrical holes, the axes of which coincide (Fig. 8) and which have the same diameter d^1. The holes d^1 are slightly greater than the mean diameter $\frac{e+f}{2}$ of the screw r but smaller than the outer diameter f. The male half-coupling constituted by screw r therefore comprises, conical portion i at one end a cylindrical central portion j and a smooth portion k at the other end which extends to the head m. The smooth portion k is, like the remainder of the coupling member, case-hardened if the metal is not already hard. The diameter d of the smooth portion k has a well determined value which will be hereinafter indicated.

In order to insert the screw r into the hole of the part B it is guided through suitable guide means, for instance a small metallic cylinder n, slit in the direction of the axis, the length h^1 of which is equal at least to the length of the cylindrical threaded portion j of the screw, and the inner diameter of which is such that it fits exactly about the threaded portion j. As soon as the screw has bitten into the cylindrical hole of part B, the cylinder n is no longer useful and, as it is slit, can easily be removed. By further pushing screw r in the direction of the arrow F, while screwing it, it is caused to penetrate into the cylindrical hole in the part B and form the first threads therein, the guide n being then removed. The screw and the part B are then in the respective positions illustrated in Fig. 9.

As the screw is rotated further, it moves forward and comes into the position shown in Fig. 10. If the screw is still further turned, three possible different phenomena may occur according to the value of the diameter d of the smooth portion k of the screw.

(1). If the diameter d is greater than $\frac{e+f}{2}$ the screw cannot penetrate further into the hole of the part B.

(2). If the diameter d is between $\frac{e+f}{2}$ and e the screw penetrates further into the hole of the part B but as it is entering therein, the smooth portion k crushes and flattens the threads formed in the part B (Fig. 11) to a greater or less degree according to the diameter of the portion k in relation to $\frac{e+f}{2}$. Consequently, the screw cannot be removed without again forming threads in the part B by the passing of the screw therethrough, and

(3). If the diameter d is smaller than the diameter e, the smooth portion k will pass through the hole in the part B without touching the threads thereof formed by the passing of the threaded portion of the screw therethrough.

As the screw moves forward, in the case

of (2) or (3), its head comes into contact with the part B, and if the smooth portion k is slightly longer than the thickness of part B, all the threads of the screw will be in the part A or will project therefrom. If then the screw is rotated further, it binds the part B against the part A, which acts in fact as a nut. If the part B is thin, that is for instance, thinner than the nut of a bolt having the same diameter as the screw, and when the threads of the screw project from the part A, a non-threaded nut o is as shown in Fig. 11, screwed thereon and tightened, the whole being securely tightened by turning simultaneously the nut o and the head m.

If the part A is of a thickness equal, at least, to the diameter of the screw, it is no longer necessary to make use of a nut such as o, since the part A through its engagement with a number of threads of the screw would be sufficient to avoid tearing, the same as if a nut were provided. It will be understood that if part B is of a thickness greater than the diameter of the screw, the friction of the meshed thread in part B acting on the smooth portion k, as the screw is moved forwardly, would oppose such forward movement of the screw. In order to avoid this, the diameter of the smooth portion k could be reduced in the region of the head m by a small amount so that the crushed thread would not act on too great a length of the portion k.

The cylindrical threaded portion j of the screw is of a length which is not greater than the diameter of the threaded shank because its insertion into the holes of parts A and B would require efforts that might be greater than the resistance of the shank to twisting.

Further in case (3) it will be noted that it is possible to remove the screw without injuring the threads. In case (2) an assembled structure is provided which cannot loosen accidentally and it is possible to remove the screw only by again forming the threads in part B by unscrewing the screw by means of a spanner. It will be appreciated that under these conditions the insertion and the removal of the screw cannot be repeated several times. In order to facilitate the removal of the screw, the rear part of the cylindrical threaded portion j may be given a slightly conical shape as shown in dotted lines in Fig. 9 at j^0.

Screws according to case (2) above referred to may therefore be utilised when the parts are to be coupled in a definitive manner, as with a rivet, but the system according to the present invention has the following advantages over the rivet:—ready fixing in recesses, no heating, no hammering and, therefore, no noise, the ready separation of the parts while ensuring a good contact of the parts and of the rivet in the direction corresponding to shearing of the shank and in that corresponding to tearing thereof.

The screwing device above described may be used for fixing parts upon thick portions of other parts by means of blind or non-threaded holes. It is therefore possible to obtain, in an inexpensive manner, the assembly of parts through stud bolts.

As shown in Fig. 12, a stud bolt q has cylindrical threaded portions j^1 j^2, which as shown have been threaded into a blind hole r having smooth walls provided in a part s. The hole r is smaller than the diameter f of the stud bolt. One end of the stud bolt comprises a conical portion i^0 which extends beyond the cylindrical portion j^1 the length of the portion j^1 being smaller than, or equal to, half the diameter of the stud bolt. Adjacent to the portion j^1 there is provided a smooth portion k^0 the diameter of which is less than the diameter of the bottom or root of the thread, and the length of which is chosen in accordance with the depth of the blind hole r (normally twice or three times the diameter of the stud bolt). Adjacent to the smooth portion k^0 there is provided a cylindrical threaded portion j^3 which extends outwardly from part s sufficiently to permit of the assembly of other parts to the part s, the portion j^2 of which being engaged in the blind hole.

The free end i^2 of stud bolt q is of conical form, the half angle of the cone being about equal to 6°, thereby making it possible to engage the stud with a nut having a cylindrical hole.

The portion of the stud bolt positioned outside the blind hole may be provided with a threaded part j^4 (Fig. 13) of greater diameter than that of the portion engaged within the blind hole and the profile of the threads of the part j^4 may be of a different form to those at j^2 and i^3, or of a form to be engaged by a normal threaded nut.

When it is necessary to frequently remove and screw back the stud bolts without the anti-loosening action due to the forcing of the threads being destroyed by wear and tear, I apply to said stud bolts the improvement described with reference to Fig. 6, that is I dispose after cylindrical portion j^2 a second conical portion i^3 as shown in Fig. 12.

It should be noted that, in Figs. 7 to 12, the dimensions of the teeth of the

thread profile have been considerably exaggerated with respect to the diameter of the screws, so as to facilitate the understanding of the explanations, but it should be well understood that the teeth of the threads are extremely fine since the apparent pitch is between 1/10 millimeter and 2 millimeters for screws of ordinary size. By way of example, in the embodiment of Fig. 11, the part A would have about ten threads in engagement with the screw.

The threads of the screws above described may be termed forced threads since they have an outer diameter larger than that of the hole in which they are to be engaged, so as to be able to form the threads in such hole by the upsetting of the material in which the hole is formed.

The present invention also includes an improvement in the utilisation of the screws from a practical point of view which consists in providing at the end of the screw or threaded rod a cylindrical threaded portion of a diameter smaller than that of the hole into which the screw engages so that it may pass freely therethrough, and in screwing onto the end either a threaded or a non-threaded nut (Fig. 14).

The end portion of the screw has a maximum length equal to one diameter of the screw and it has preferably the same pitch, thread profile and number of threads as the remainder of the screw.

The nut threaded in advance, although it is not provided with an anti-loosening thread, is maintained securely on the screw in the same manner as a lock nut. It may comprise, in order to allow for variations in the thickness of the parts to be connected, a recess in which may be housed the conical portion of the screw if it happened to project, but it is preferable not to provide such a chamber, and if the conical portion projects, to add a washer.

The practical advantage that results from the existence of the portion of cylindrical shape and of smaller diameter is to considerably reduce the effort required for introducing the screw, which, in the preceding embodiments correspond to the forcing of a threaded portion of a length at least equal to one diameter, and which, owing to this improvement, corresponds to the forcing of only some threads. The end of the cylindrical portion thus added to the screw may itself be provided with a conical chamber, which facilitates the insertion of the screw in the parts or permits the insertion of a non threaded cylindrical nut onto the screw.

Fig. 14 shows the screw with threads smaller than those shown in Figs. 8 to 11, as compared with the said screw, but even in this instance the size of the threads has been exaggerated for the sake of clearness.

In Fig. 14 the smooth portion h of the bolt or screw v, is of diameter d which is smaller than the diameter d^1 of the hole, and the diameter f of the cylindrical portion j of the bolt or screw is of a diameter greater than the diameter d^1. At i is indicated the conical portion necessary for inserting and forcing the threads.

At u is shown the cylindrical portion of a diameter d^2 smaller than d^1, and t indicates the end for facilitating the insertion.

It goes without saying that the insertion of the screws is facilitated by abundant lubrication.

Stud bolts of the form shown in Figs. 11 and 13 may be employed to connect together parts formed of soft cast iron, but when used in connection with parts formed of hard cast iron, a modification of the stud bolts is desirable. A modified form of stud bolt for use with hard cast iron is illustrated in Fig. 15. This form of stud bolt is made of, for example, case-hardened soft steel, and one end thereof is of a particular construction, as hereinafter set forth. The stud bolt is capable of being introduced into hard cast iron without deformation of the threads, and is less expensive than stud bolts made of hard material.

The end of said stud bolt c is given one or several grindings, if the operation is performed after hardening, or one or several millings, if the operation is effected before hardening, so as to form at the end of the conical or threaded portion c^1 a longitudinal groove c^2 analogous to that of taps.

Owing to the presence of the groove, the first threads of the conical portion will cut into the hard cast iron while the last threads of the said conical portion will penetrate into the cast iron by forcing, but said forcing action is much less important since a portion of the metal has been removed by the first cutting threads.

Similar grooves may be provided in the screws when the screws are not provided at their end with a cylindrical portion. In order to produce said grooves I make use of grinding wheels or milling cutters of very small radius. In Fig. 15, d^1 indicates the diameter of a hole in the piece of hard cast iron; such that $\frac{f+f}{2} < d^1 < f$, at x the zone in which the edges of the said hole are cut by the cutting edges of the threaded portion resulting from the existence of the longitudinal groove c^2,

and

at y the zone that corresponds to the forcing of the conical threads into the hole.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is :—

1. A method of coupling together male and female metallic parts, adapted to resist shearing and bending stresses, one of the parts being threaded and of hard material and another being non-threaded and of less hard material so that by forcing one part into or onto the other and rotating, screw threads will be formed in or on the non-threaded part, characterized in that one of the parts is cylindrical, whilst the other one is cylindro-conical, that is to say it forms a conical inlet portion followed by a cylindrical portion, the diameter of the non-threaded cylindrical portion and the diameters of the threaded cylindrical portion measured at the bottom and at the top of the threads respectively being so arranged that the metal or matter of the non-threaded part that is crushed by the screwing of the threaded part can be housed between the teeth or threads of the threaded part, that is to say that there remains a slight play or clearance between the bottom of the threads of the threaded part and the top of the threads formed in the non-threaded part.

2. A coupling method according to claim 1, further characterized in that the diameter of the non-threaded cylindrical portion ranges between the diameter at the bottom of the threads of the screw threaded cylindrical portion and the arithmetical mean of this diameter and of the diameter at the top of the threads of the threaded portion ($D^2 < D^1 < \frac{D^2 + D^3}{2}$, in the case of Figure 2), when the smooth cylindrical surface is on the male part, or between the arithmetical mean of these two diameters and the outer diameter of the screw threads ($f > d > \frac{e+f}{2}$, in the case of Figure 7), when the non-threaded cylindrical surface is in the female part.

3. A method according to claim 1 or 2, further characterized in that the cylindro-conical portion is prolonged on the side opposite to its inlet end by a converging conical portion, that is to say a portion that narrows or tapers towards the common axis of the parts to be assembled.

4. A method of coupling together male and female members, wherein a cylindro-conical portion of one of the members is prolonged, on the side opposite to its inlet end, by a converging conical portion, that is to say a portion (such as r^3 Figure 13) which diverges from the common axis of the parts to be assembled when the screw-threaded member is a male member, the part of the female member engaging therewith being smooth.

5. A method according to claim 1 further characterizel in that recesses or grooves (k, l) are provided in the cylindrical portion of the cylindro-conical threaded parts to be coupled.

6. A method according to claim 1 applicable to the assembling of two tubes or rods by a single coupling member, characterized in that the coupling member comprises two threaded conical end portions (a^2, a^1, Figure 1), and a cylindrical middle portion (a^3), the conicity concerning either the tops of the threads only or both the tops and the bottoms of the threads.

7. A method according to claim 1, further characterized in that one of the two parts form the head of a bolt (a^5 Figure 5) or the nut of a bolt (a^6), while the other one forms the shank of a bolt.

8. A method according to claim 1, further characterized in that one of the parts to be assembled which part is in the form of a bolt, is screw threaded and of cylindro-conical shape, the conicity being afforded either by cutting off the tops of the threads at one end of the said part or by forming a thread thereon, the tops and the bottoms of which are located in conical surfaces, while the other part or each other part to be assembled, such as a metallic sheet, is provided with a cylindrical hole, a smooth portion extending between the head of the bolt and the first thread thereof (k Figure 8) having a diameter ranging between the diameter at the bottom of the threads of the threaded cylindrical portion, and the diameter d^1 of the cylindrical hole, and of a length greater, but only by a small amount, than the thickness of the metal sheet or of the pieces through which it first passes (k greater than B, Figure 11) which prevents the bolt from becoming loosened accidentally.

9. A method according to claim 8, further characterized in that, at the end of the threaded bolt there is provided a cylindrical threaded portion of a diameter smaller than that of the hole into which the screw is forced, a nut being screwed on the said end that passes freely through the hole.

10. A method according to claim 8, further characterized in that the portion that projects out from the part in which the stud bolt is forcibly screwed is cylindro-conical, that is to say, consists of a cylindrical portion j^2 and of a flaring

conical portion i^3 eventually prolonged by a portion j^4 provided with threads of any shape.

11. A method according to claim 1, further characterized in that the threaded cylindro-conical part is a stud bolt, a groove i^2 being provided along a portion only of the length of the conical portion.

12. A method of coupling metallic parts substantially as hereinbefore described with reference to any of the examples illustrated in the accompanying drawings.

Dated this 19th day of January, 1933.

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SHEET 1

Fig. 1.

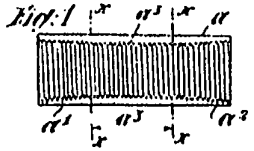


Fig. 2.

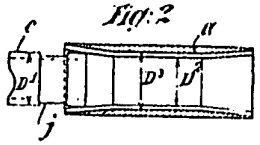
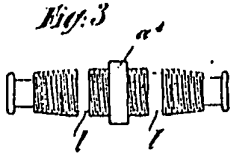


Fig. 3.



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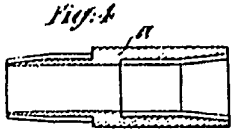

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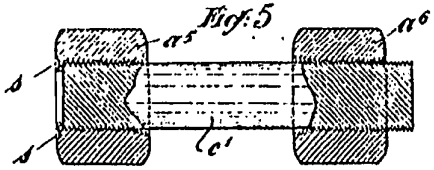

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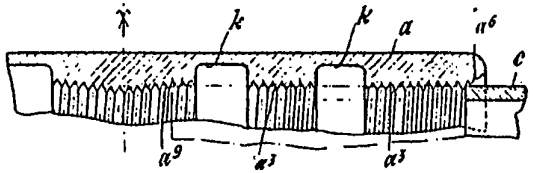
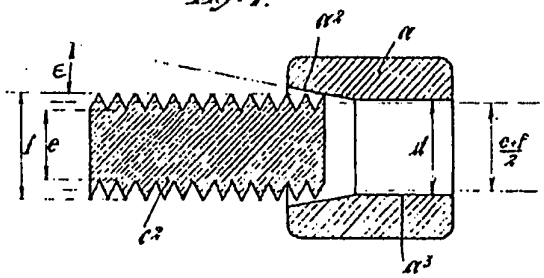


SHEET 2

Fig. 7.



SHEET 3

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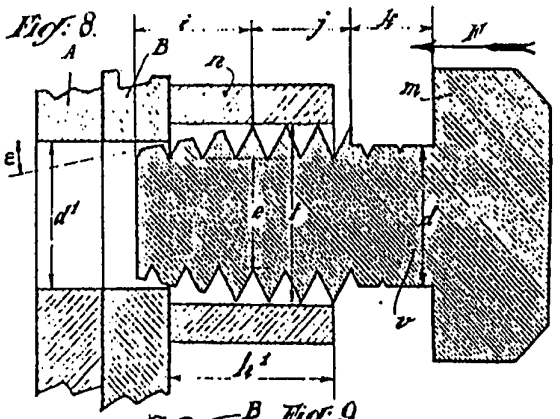

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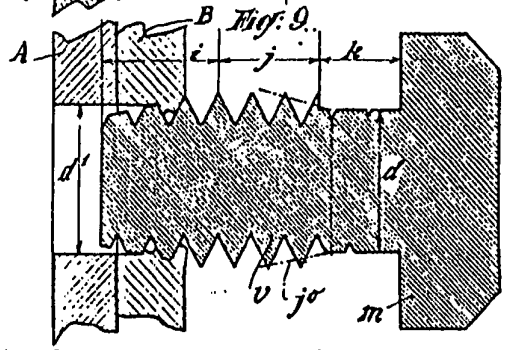

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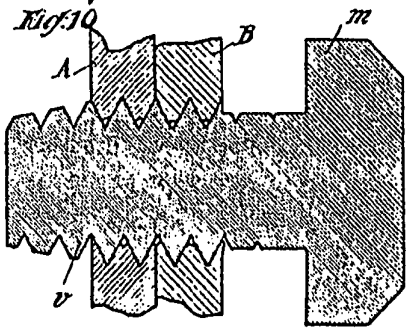

[This Drawing is a reproduction of the Original on a reduced scale.]

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413,027 COMPLETE SPECIFICATION

SHEET 1

Fig. 1

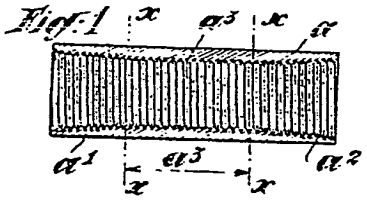


Fig. 2

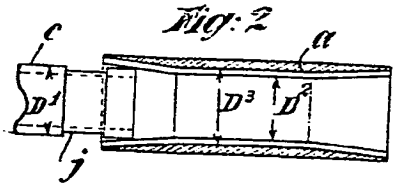
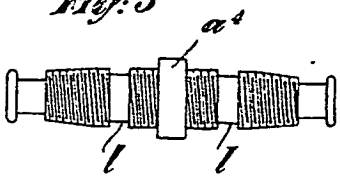


Fig. 3



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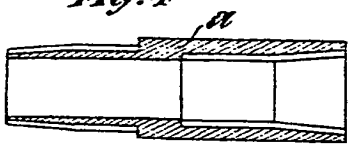

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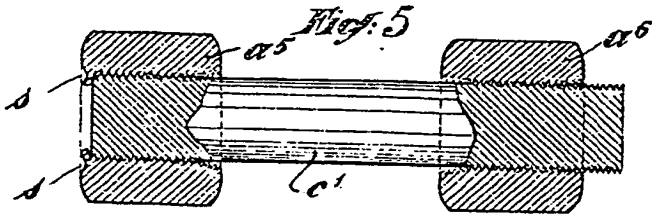

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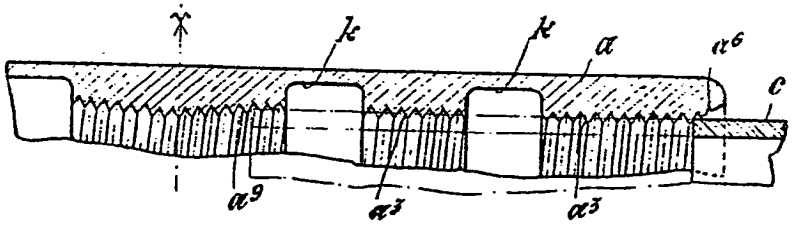

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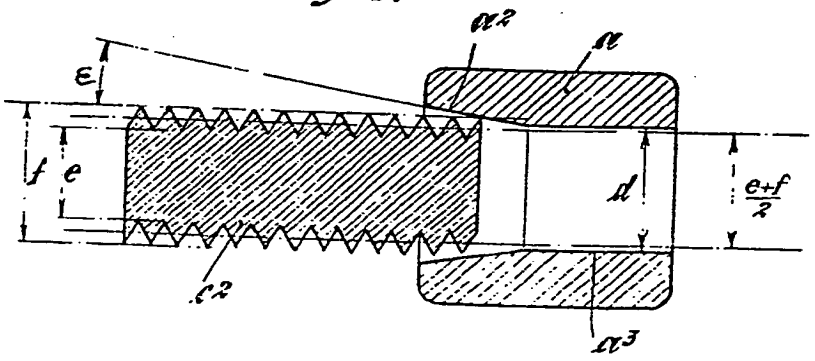
SHEET 2

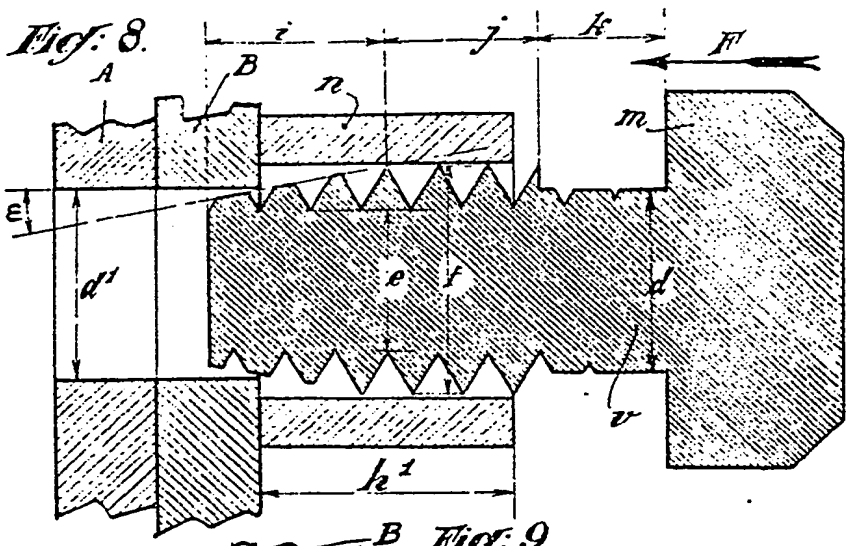
Fig. 7.



4 SHEETS

SHEET 1

SHEET 3



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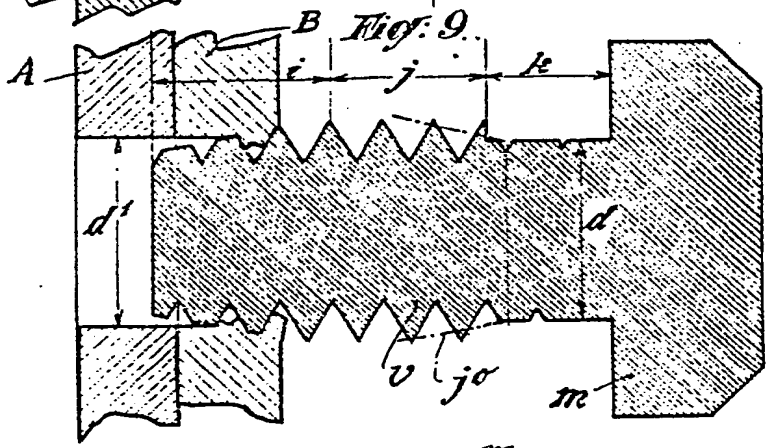

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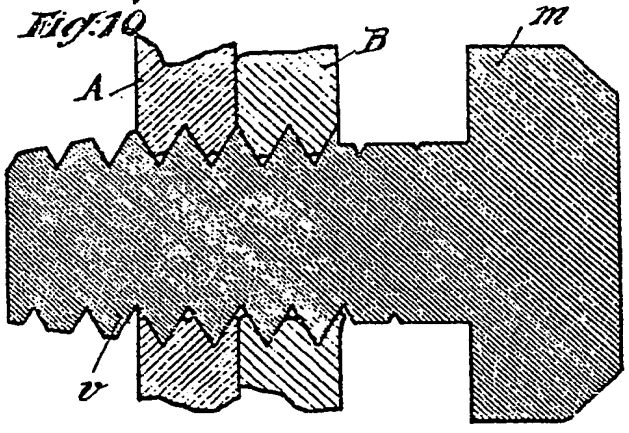

Fig. 10.

SHEET 2

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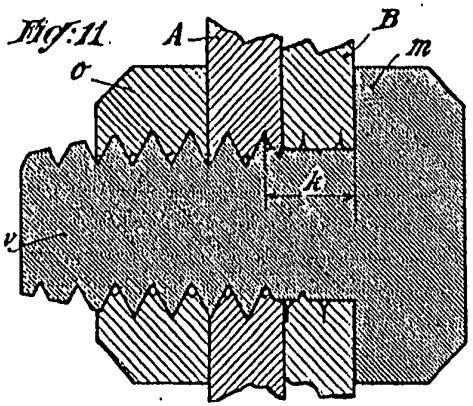
Fig:11.



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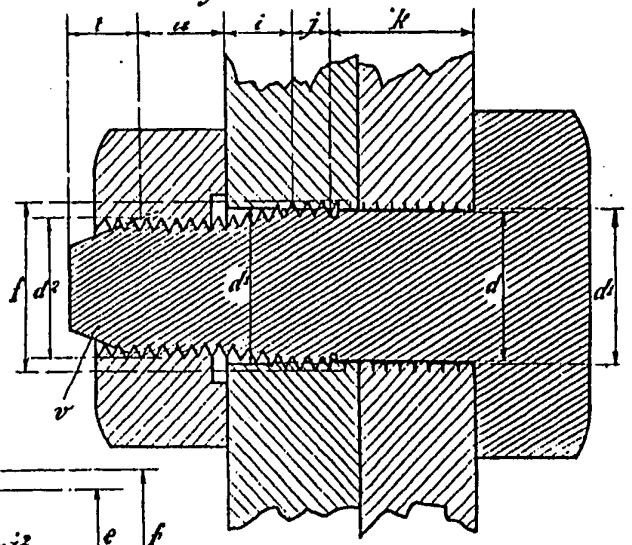

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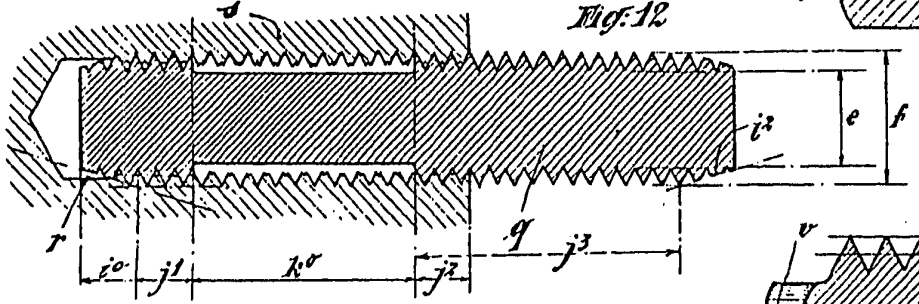

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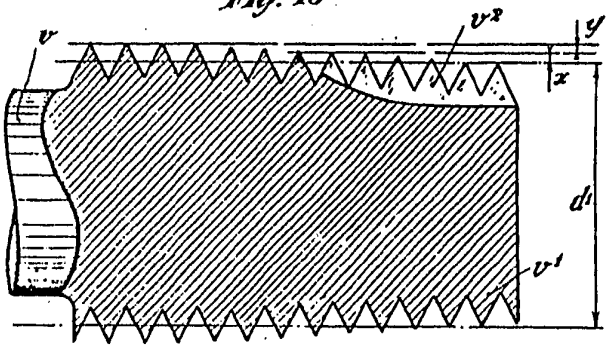

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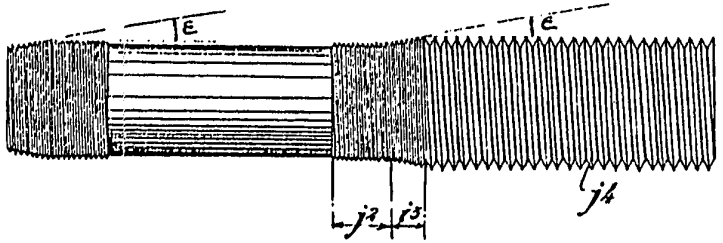

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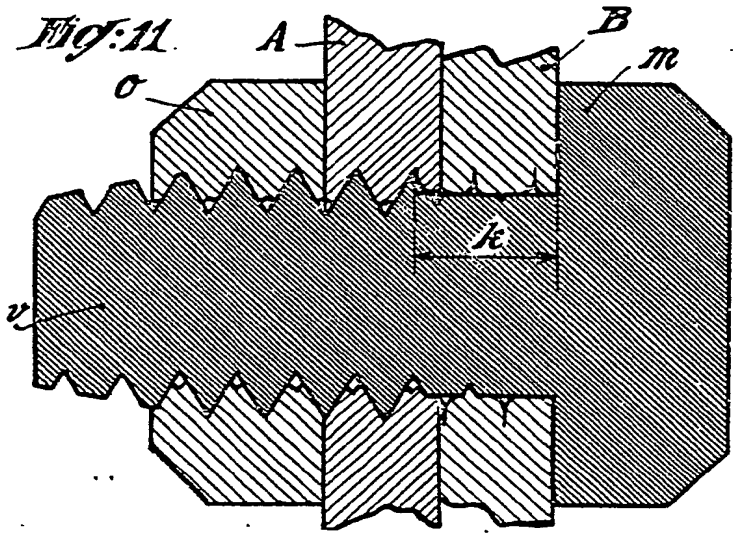
Fig: 11.



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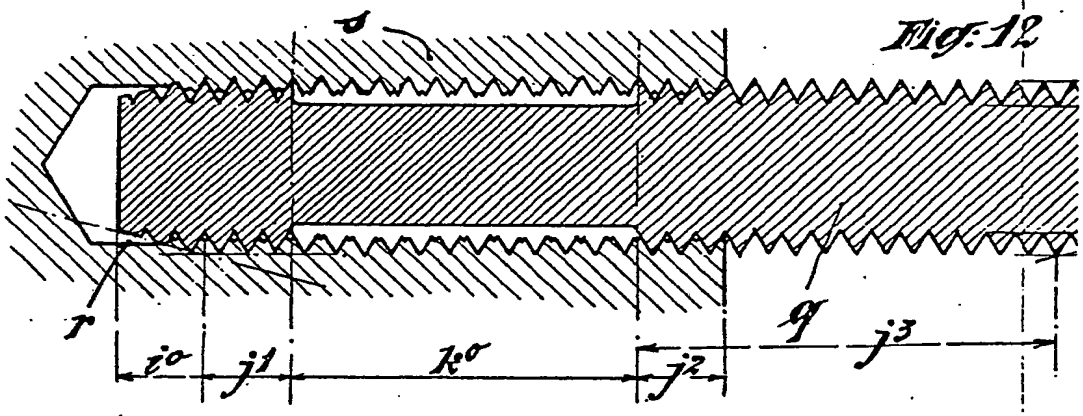

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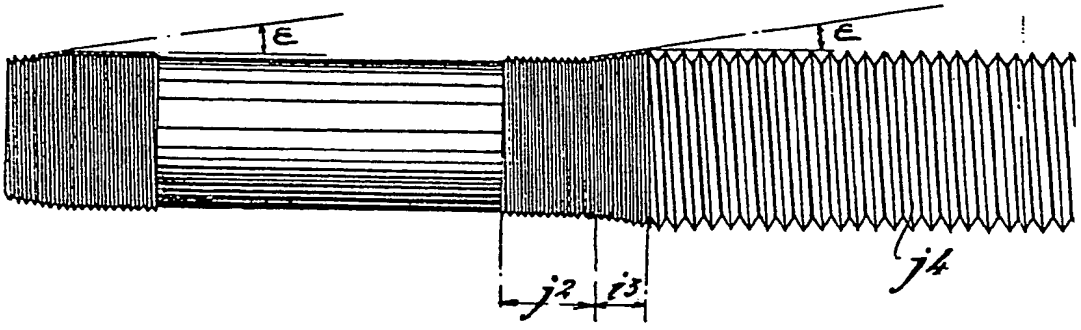

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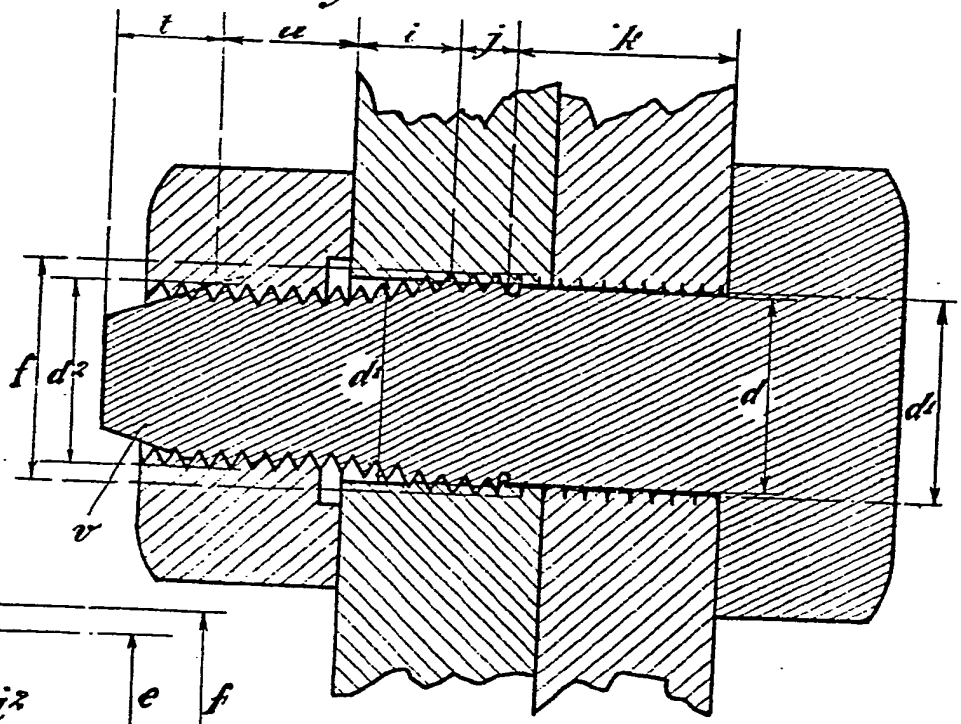
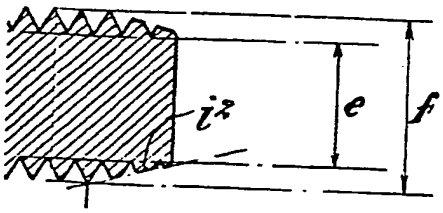


Fig. 12



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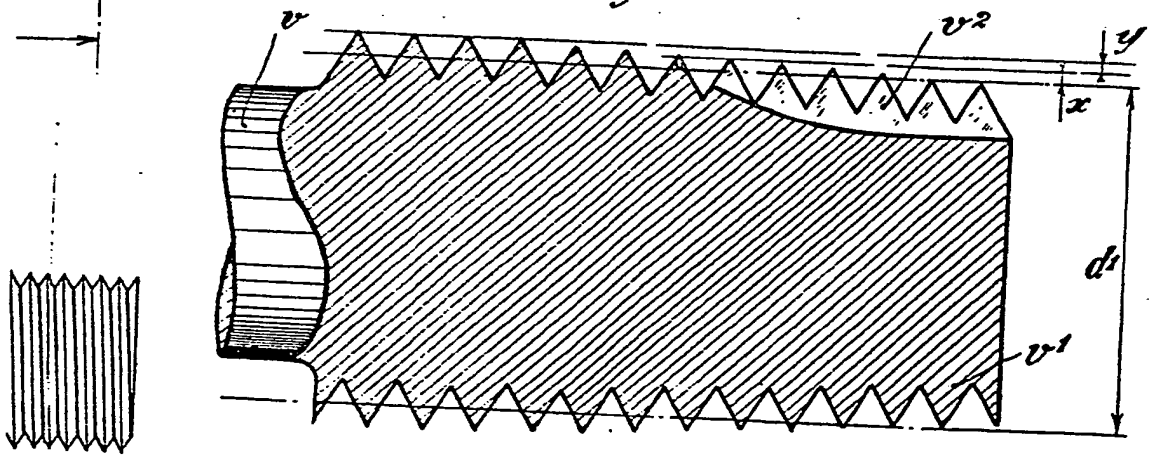

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